

REMARKS

This application has been reviewed in light of the Office Action mailed December 4, 2003. Claims 1, 6 and 18 have been amended without adding new matter. Claims 1-8, 10-46 and 48-57 are pending in this application. Reconsideration of the application is respectfully requested in light of the following remarks. The following remarks discuss the eight different rejections in a different order than presented in the Office Action in an attempt to discuss the claims in ascending order.

Claims 1-4, 7, 8 and 18 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Lin, U.S. Patent No. 6,333,562 (hereinafter “Lin”). This rejection is traversed for the following reasons.

Claim 1 recites a “wire bonded structure comprising: ... a first wire bond ...; a second wire bond ..., wherein ... at least one of said first and second wire bonds at said second bonding area being on top of the other of said first and second wire bond at said second bonding area.” An embodiment of this feature of the invention is illustrated and described in Figure 5B and accompanying text of the specification, for example, which disclose a first wire bond 54 and a second wire bond 60 at a bonding area. The invention is not limited to the disclosed embodiments.

Lin fails to teach or suggest this limitation. The Office Action asserts that Lin teaches a “second bonding area (330a) and ... a first wire bond (360) ... , a second wire bond (370) ... and at least one of the bonds (370) at the second area being on top of the other bond (figure 4).” Office Action, p. 5. This is an incorrect characterization of Lin. With reference to Figure 4, Lin’s bonding wires 360 and 370 at the “second area (330a)” are not “on top of the other.” To the contrary, as clearly shown in Figures 3 and 4, Lin’s bonding wires 360, 370 are laterally spaced apart on separate conductive leads 330a. Thus, Lin fails to teach or suggest the above recited limitation of claim 1.

Further, claim 1 recites a “first wire bond ... [and] a second wire bond ... wherein a bump is at one end of each of said first and second wire bonds.” An exemplary

embodiment having this feature of the invention is illustrated in Figure 5B which shows a bump 50 at one end of wire bond 54, and a bump 56 at one end of wire bond 60. The invention is not limited to the disclosed embodiments.

Lin fails to teach or suggest this limitation, and the Office Action does not assert that Lin meets this limitation. Lin teaches only one bump 350 at an end of one bonding wire 360. Lin does not teach or suggest any other bumps at the end of bonding wire 370. Thus, Lin also fails to teach or suggest this limitation of claim 1.

For at least these reasons, Lin fails to anticipate claim 1 and claim 1 is allowable over Lin. Claims 2-4, 7 and 8 depend from claim 1 and contain every limitation of claim 1. Claims 2-4, 7 and 8 should be allowed for at least the same reasons as for allowance of claim 1, and also because the unique combinations recited by these dependent claims are neither taught nor suggested by Lin.

Claim 18 recites a “wire bonded structure comprising: a first conductive bump on a first bonding surface; ... [and] a first wire bond extending ... to said first conductive bump; a second conductive bump on a third bonding surface; .. and a second wire bond between ... [a] ball bond and said second conductive bump.” As discussed above with respect to claim 1, Lin fails to teach or suggest a bump at an end of two wire bonds, and claim 18 is allowable over Lin for at least this reason.

Claims 1-5, 7 and 10-39 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Heo, U.S. Patent No. 6,555,917 (hereinafter “Heo”). This rejection is respectfully traversed for the following reasons.

Claim 1 has been amended to recite “at least one of said first and second wire bonds at said second bonding area being on top of the other of said first and second wire bond at said second bonding area, and wherein one of said bumps is formed on said second bonding area in electrical communication with said first and second wire bonds.” Heo fails to teach or suggest this limitation. Heo teaches, with reference to Figure 8B (relied upon

by the Office Action), two wires 30 attached to a circuit pattern 18. However, Heo fails to teach or suggest that a bump is formed on the circuit pattern 18 in electrical communication with the wires 30, as recited in amended claim 1.

For at least this reason, Heo fails to anticipate claim 1. Claims 2-5, 7 and 10-13 depend from claim 1 and should be allowed for at least the reasons for allowance of their base claim, and for other reasons.

For example, claim 10 recites that “an imaginary line drawn along a longitudinal axis of said first wire bond and an imaginary line drawn along a longitudinal axis of said second wire bond are not parallel;” claim 11 recites that “an intersection between said imaginary lines forms an angle in a horizontal plane;” claim 12 recites that “an intersection between said imaginary lines forms an angle in a vertical plane;” and claim 13 recites that “an intersection between said imaginary lines forms an angle in vertical and horizontal planes.” Heo fails to teach or suggest these limitations. The Office Action asserts that “[t]hese angles are disclosed in column 4 lines 35-45.” The cited section of Heo, however, discusses angles of the wire 30 relative to the active surface 11a. This is not the same as the relationship between the wires themselves, as recited in claims 10-13. These are additional reasons why claims 10-13 are allowable over Heo.

Claim 14 recites a “second wire bond formed from said bonding pad of said lower chip to a bonding pad of said upper chip and electrically connected to said first wire bond.” Heo fails to teach or suggest this limitation, nor does the Office Action suggest that Heo meets this limitation. Heo discloses wires formed between chips 10-1, 10-2 and a substrate 12, but not from a “bonding pad of said lower chip to a bonding pad of said upper chip” as recited in claim 14.

Moreover, claim 14 also recites that “said first wire bond and said second wire bond are configured such that an imaginary line drawn between endpoints of said first wire bond and an imaginary line drawn between endpoints of said second wire bond are not

parallel.” As discussed above with respect to claim 10, Heo fails to teach or suggest this limitation.

For at least these reasons, claim 14 is allowable over Heo. Claims 15-17 depend from claim 14 and should be allowed for at least the same reasons as for allowance of their base claim, and for other reasons.

Claim 18 recites a “first conductive bump ...; ... a first wire bond extending ... to said first conductive bump; ... a second ball bond ... in electrical communication with said first conductive bump; and a second wire bond between said second ball bond and said second conductive bump.” Thus, claim 18 recites a “first conductive bump,” a “first wire bond” extending to the same bump, and a “second wire bond” in electrical communication with the same bump via a second ball bond. As discussed above with respect to claim 1, Heo fails to teach or suggest this limitation, and claim 18 is allowable over Heo based on at least this reason. Claims 19-23 depend from claim 18 and should be allowed for the reasons claim 18 is allowable, and for other reasons.

Claim 24 recites a method comprising “connecting said first wire bond on at least one end using a ball bond on top of a first conductive bump.” Heo fails to teach or suggest this limitation. The Office Action asserts only that in Heo a “ball bond is present at one end of the first and second bonds (32) with a bump at the other end (34). Figure 10 shows a ball bonded to the bump.” Office Action, p. 6. Initially, this assertion, even if true (and it is not) does not meet the claim limitation of a “ball bond on top of a first conductive bump.” And further, Heo does not teach the forming of ball bonds as asserted in the Office Action. For at least these reasons, claim 24 is allowable over Heo. Claims 25-33, dependent from claim 24, are allowable over Heo for at least the same reasons.

Claim 34 recites a method comprising “forming a first conductive bump ...; ... forming a first wire ... to said first conductive bump; ... forming a second ball bond ... in electrical communication with said first conductive bump; and forming a second wire bond from said second ball bond to said second conductive bump.” As discussed above with

respect to claim 1, Heo fails to teach or suggest a conductive bump in electrical communication with a first and second wire bonds. For at least this reason, claim 34 is allowable over Heo. Claims 35-39 depend from claim 34, and should be allowed over Heo for at least the same reasons as for allowance of claim 34, and for other reasons.

Claims 14, 16 and 24-33 stand rejected under 35 U.S.C. § 102(a) as being anticipated by Chen et al., U.S. patent application publication no. US 2003/0042621 (hereinafter “Chen”). This rejection is respectfully traversed for the following reasons.

Claim 14 recites “a first wire bond formed from a bonding pad of said substrate to a bonding pad of said lower chip; [and] a second wire bond formed from said bonding pad of said lower chip to a bonding pad of said upper chip and electrically connected to said first wire bond.” Chen fails to teach or suggest this limitation. Chen teaches a bond pad 122 on a substrate 118, and two wires extending from the bond pad 122: one wire 134 extending to a first chip, and another wire 130 extending to a second chip. Chen fails to teach or suggest “a second wire bond formed from said bonding pad of said lower chip to a bonding pad of said upper chip and electrically connected to said first wire bond,” which is “formed from a bonding pad of said substrate.” For at least this reason, claim 14 is allowable over Chen.

Moreover, claim 14 recites a “wire bonded structure comprising: ... a first wire bond [and] ... a second wire bond ... wherein said first wire bond and said second wire bond are configured such that an imaginary line drawn between endpoints of said first wire bond and an imaginary line drawn between endpoints of said second wire bond are not parallel.” This feature of the invention is illustrated, for example, in the embodiments shown in Figures 5B, 6 and 8, and described in the accompanying text in the specification. The invention is not limited to the disclosed embodiments.

Chen fails to teach or suggest this limitation. In the “Response to Arguments” section, the Office Action asserts that Chen discloses in figure 4 that a “first (130) and second (134) wire bond start and end at the same pad and have their respective start and

end in different areas which would force the lines to intersect.” Office Action, p. 9. This statement is not only incorrect, but also is mere speculation by the Office Action. That wires 134 and 130 start in a similar place and end in different places does not “force the lines to intersect.” As seen in Figure 4, lines 130 and 134 end at different locations because the lines lead to different elevations. This does not “force the lines to intersect,” as suggested by the Office Action. The lines 130 and 134 could be parallel and lead to different elevations. The Office Action’s assertion is an improper characterization of Chen, reading something into the reference which the reference does not teach, in an attempt to arrive at the claimed invention. This is another reason why claim 14 is allowable over Chen.

For at least these reasons, claim 14 is allowable. Claim 16 depends from claim 14 and contains every limitation of claim 14. Claim 16 is allowable for at least the same reasons as for allowance of claim 14, and also because the unique combinations recited by this dependent claim are neither taught nor suggested by Chen. For example, claim 16 recites that an “an intersection between said imaginary lines forms an angle in a vertical plane.” This is another reason why claim 16 is allowable.

Claim 24 relates to a method for wire bonding. Claim 24 recites “forming a first wire bond between first and second components; [by] … connecting said first wire bond on at least one end using a ball bond on top of a first conductive bump.” Chen fails to teach or suggest this limitation because it shows only that a stitch-type bond 130 is formed on top of its bump 132. Paragraph [0071]; Figure 4. In the “Response to Arguments” section, the Office Action asserts that “Figure 7D shows a ball bond formed on top of a bump 206.” Office Action, page 9. This is a mischaracterization of Chen. Figure 7D of Chen shows a stitch bond 210 on top bump 206, not a ball bond. See also paragraph [0074] of Chen. For at least this reason Chen fails to anticipate claim 24, and claim 24 is allowable over Chen.

Claims 25-33 depend from claim 24 and contain every limitation of claim 24. Claims 25-33 should be allowed for at least the same reasons as for allowance of claim 24,

and also because the unique combinations recited in these dependent claims are not anticipated by Chen.

Claims 14-17, 42-46 and 48-57 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Yin et al., U.S. patent application publication no. 2003/0049882 (hereinafter “Yin”). Reconsideration is respectfully requested for the following reasons.

Claim 14 recites “a first wire bond formed from a bonding pad of said substrate to a bonding pad of said lower chip; [and] a second wire bond formed from said bonding pad of said lower chip to a bonding pad of said upper chip and electrically connected to said first wire bond.” Yin fails to teach or suggest this limitation. With reference to Figure 6, Yin teaches a wire 90 extending from a substrate 20 to a lower component 80, and a wire 76 extending from the substrate to an upper component 30. No wires in Yin are formed from the lower component to the upper component. For at least this reason, claim 14 is allowable over Yin.

Moreover, claim 14 recites a “first wire bond … [and] a second wire bond … electrically connected to said first wire bond; and wherein said first wire bond and said second wire bond are configured such that an imaginary line drawn between endpoints of said first wire bond and an imaginary line drawn between endpoints of said second wire bond are not parallel.” Yin fails to teach or suggest this claim limitation.

In the Response to Arguments” section, the Office Action asserts that in Figure 6 “the first (90) and second (76) wire bonds start and end at the same pad and start and end respectively in different areas which would force the lines to intersect.” This statement is incorrect. The lines 90 and 76 in Yin end at different locations because they lead from a substrate to components at different elevations. This in no way would “force the lines to intersect.” Such a statement is not only incorrect, but is also a reinvention of Yin. For this additional reason claim 14 is allowable.

Claims 15-17 depend from claim 14 and contain every limitation of claim 14. Claims 15-17 should be allowed over Yin for the same reasons as for allowance of claim 14, and for other reasons.

Claim 42 recites a device that “forms a first wire bond … [and] a second wire bond … wherein said first and second wire bonds are electrically connected on said second surface, and wherein said second wire bond is formed at an angle with respect to said first wire bond in a horizontal plane.” As discussed above in connection with claim 14, Yin does not teach or suggest this limitation. For at least this reason, claim 42 and claims 43-46, 48 and 49 dependent therefrom are allowable over Yin.

Claim 50 recites a controlled device that forms a “first conductive bump on a first conductive surface, … [and] a second conductive bump on a third surface.” Yin teaches only one bump 56, formed on component 30, under one of the two wire bonds. This argument has yet to be addressed by the Office Action. The Office Action asserts only, in the “Response to Arguments” section, that “[i]f the prior art structure is capable of performing the intended use, then it meets the claim.” Office Action, p. 11. However, as discussed above, Yin does not teach or suggest the above-recited limitation of claim 50, and, thus, cannot be said to be “capable” of performing the limitation of claim 50. To suggest otherwise is mere speculation on the part of the Office Action.

For at least these reasons, claim 50 is allowable over Yin. Claims 51-57 depend from claim 50 and should be allowed for at least the same reasons as for allowance of their base claim, and for other reasons.

Claims 42-46 and 48-57 stand rejected under 35 U.S.C. 102(b) as being anticipated by Biggs et al., U.S. Patent No. 5,702,049 (hereinafter “Biggs”). Reconsideration is respectfully requested for the following reasons.

Biggs relates to an angled wire bonding tool and alignment method. Biggs does not teach or suggest that its tool comprises “a mechanism … that … forms a first wire

bond from a first surface to a second surface, and forms a second wire bond from said second surface to a third surface, wherein said first and second wire bonds are electrically connected on said second surface, and wherein said second wire bond is formed at an angle with respect to said first wire bond in a horizontal plane,” as recited in claim 42. The Office Action suggest only that the Biggs tool is “capable of forming bonds at an angle to the horizontal (figure 6) and to the vertical (figures 3A and 19).” Even if true, this assertion fails to account for the limitations of claim 42 recited above. For at least these reasons Biggs fails to anticipate claim 42. Thus, claim 42, and claims 43-46, 48 and 49 dependent therefrom are allowable over Biggs.

Claim 50 recites an apparatus comprising a “controller for controlling a wire bonding device such that said device forms a first conductive bump on a first conductive surface, a first ball bond on a second conductive surface, a first wire bond from said first ball bond to said first conductive bump, a second conductive bump on a third surface, a second ball bond on said second conductive surface in electrical communication with said first conductive bump, and a second wire bond from said second ball bond to said second conductive bump.” The Office Action asserts only that the Biggs tool is “capable of forming bonds at an angle to the horizontal (figure 6) and to the vertical (figures 3A and 19).” This assertion fails to account for any of the limitations of claim 50 recited above. For at least these reasons, Biggs fails to anticipate claim 50. Thus, claim 50, and claims 51-57 dependent therefrom are allowable over Biggs.

Claims 42-46 and 48-57 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Fujishima, U.S. Patent No. 6,148,505 (hereinafter “Fujishima”). Reconsideration is requested in light of the following.

Claim 42 recites an apparatus comprising a “mechanism … that … forms a first wire bond from a first surface to a second surface, and forms a second wire bond from said second surface to a third surface, wherein said first and second wire bonds are electrically connected on said second surface, and wherein said second wire bond is formed at an angle

with respect to said first wire bond in a horizontal plane.” Fujishima fails to teach or suggest these limitations.

The Office Action asserts Fujishima’s “control unit comprises a computer and software (program, col 9 lines 37-45) for measuring (determining) and positioning the capillary accordingly and is capable of forming bonds at an angle (col 5 lines 18-55).” Office Action, p. 4. In the “Response to Arguments” section, the Office Action adds that “[i]f the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art.” Office Action, p. 9.

Initially, claim 42 is not drawn to a “process for making,” but rather to an “apparatus.” Further, the Office Action failed to even assert or explain how the Fujishima device is capable of performing the “intended use” because the Office Action failed to explain how the Fujishima device could perform each and every limitation recited in claim 42. Fujishima fails to teach or suggest the limitations of claim 42, and claim 42, and claims 43-46, 48 and 49 dependent therefrom are allowable over Fujishima.

Claim 50 recites a wire bonding apparatus comprising a controller for controlling a wire bonding device. According to claim 50, the “device forms a first conductive bump on a first conductive surface, a first ball bond on a second conductive surface, a first wire bond from said first ball bond to said first conductive bump, a second conductive bump on a third surface, a second ball bond on said second conductive surface, and a second wire bond from said second ball bond to said second conductive bump.” None of these limitations are taught or suggested by Fujishima, nor does the Office Action explain to the contrary. For at least these reasons, and the reasons discussed with respect to claim 42 above, claim 50 and claims 51-57 dependent therefrom are allowable over Fujishima.

Claims 42-46 and 48-57 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Nagaoka et al., U.S. Patent No. 5,292,050 (hereinafter “Nagaoka”). Reconsideration is respectfully requested.

Claim 42 recites an apparatus comprising a “device … [that] forms a first wire bond from a first surface to a second surface, and forms a second wire bond from said second surface to a third surface, wherein said first and second wire bonds are electrically connected on said second surface, and wherein said second wire bond is formed at an angle with respect to said first wire bond in a horizontal plane.”

Nagaoka fails to teach or suggest these claim limitations. Nagaoka relates to determining the angle and distance of a wire bond between two points. Column 5, line 9 to column 6, line 18. Nagaoka does not teach or suggest a device for forming two wire bonds, which are formed at an angle in a horizontal plane, as claimed in claim 42.

The Office Action, in the “Response to Arguments” section, asserts that “[i]f the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art.” Office Action, p. 10. However, claim 42 is directed at an “apparatus” rather than a “process of making.” And, the Office Action has failed to demonstrate how the device of Nagaoka is capable of performing the “intended use” because the Office Action failed to explain how the Nagaoka device could perform each and every limitation recited in claim 42.

Thus, Nagaoka fails to teach or suggest the limitations of claim 42, and claim 42 is allowable over Nagaoka. Claims 43-46, 48 and 49 depend from claim 42 and should be allowed together with their base claim.

Claim 50 recites a “device [that] forms a first conductive bump on a first conductive surface, a first ball bond on a second conductive surface, a first wire bond from said first ball bond to said first conductive bump, a second conductive bump on a third

surface, a second ball bond on said second conductive surface.” None of these limitations are taught or suggested by Nagaoka, nor does the Office Action attempt to explain to the contrary. For at least these reasons, and the reasons discussed above with respect to claim 42, claim 50 and claims 51-57 dependent therefrom are allowable over Nagaoka.

Claims 40 and 41 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Heo in view of Koduri et al., U.S. Patent No. 6,629.013 (hereinafter “Koduri”). This rejection is based upon the rejection of independent claim 34 as being anticipated by Heo. As discussed above, Heo fails to teach or suggest all of the limitations of claim 34. Claims 40 and 41 depend from claim 34 and contain every limitation of claim 34. Koduri adds nothing to remedy Heo’s deficiencies with respect to claim 34, and the Office Action does not contend to the contrary. Thus, claims 40 and 41 are allowable over the proposed combination of Heo and Koduri.

In addition, Applicants do not agree that the references are properly combinable as proposed in the Office Action. Heo relates to a package having stacked semiconductor chips, whereas Koduri relates to a method to reduce bond program errors of integrated circuit bonders. The Office Action’s assertion, that the references could be combined to “achieve interconnection of a plurality of high density interconnections in a fast and reliable manufacturing process,” is not founded upon the teachings of the references themselves or a problem identified in the art. There exists no motivation or reason to combine the disparate teachings of the two references other the teachings of the claimed invention. For at least this reason, the references are not properly combinable.

The Office Action admits that in Heo there is not “disclosure of a computer program for monitoring and controlling movement.” Office Action, page 8. For this shortcoming, the Office Action relies on Koduri, and asserts that it would have been obvious to combine the references to “achieve interconnection of a plurality of high density interconnections in a fast and reliable manufacturing process.” *Id.*

Applicants note with appreciation the indication that claim 6 would be allowable if rewritten in independent form to include all of the limitations of its base and intervening claims. To this end, claim 6 has been rewritten in independent form to incorporate the limitations of its base and intervening claims. Claim 6 is considered to be allowable.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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